WATER RESOURCES REPORT 15

WATER POSSIBILITIES FROM THE GLACIAL DRIFT OF ANDREW COUNTY

BY

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MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES

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1957

STATE OF MISSOURI
Department of Business and Administration
Division of
GEOLOGICAL SURVEY AND WATER RESOURCES
Thomas R. Beveridge, State Geologist
Rolla, Missouri

WATER POSSIBILITIES FROM THE GLACIAL DRIFT OF ANDREW COUNTY

A special study of groundwater by the Missouri Geological Survey and Water Resources was made possible at the 1955 session of the Missouri Legislature. With the approval of the Governor, money was appropriated from the Missouri Post War Surplus Reserve Fund.

Since nearly two-thirds of the counties located north of the Missouri River are deficient in water supplies, much of the effort of this special study is being directed toward the problems of this area.

It has been shown that a program of test drilling can locate new reserves of groundwater. Potential areas are being tested so that additional supplies will be available for domestic, irrigation, industrial and municipal needs.

The most favorable areas are in the sand and gravel filled channels and valleys of pre-glacial and inter-glacial streams. Since these buried valleys do not conform to present day drainage patterns, a systematic program of test drilling is a principal means of locating the channels and mapping their extent. Such glacial deposits have proved to be excellent sources of groundwater.

QUALITY OF WATER FROM ROCK WELLS

The water from the consolidated rock formations which underlie Andrew County is, for the most part, mineralized. The following are analyses from water wells and oil tests.

CONSTITUENTS	IN PARTS PER MILLION				
	A	B	C	D	E
Turbidity	1	Turbid	Turbid	Turbid	Turbid
Odor	None	None	Oily	None	Oily
pH	7.65				
Alkalinity ($CaCO_3$)	377.0	464.1	367.9	364.7	510.4
Phenolpthalein	36.0				
Methyl Orange	341.0				
Carbonate (CO_3)	20.6	19.9	5.8	2.8	2.8
Bicarbonate (HCO_3)	416.0	566.0	448.7	444.8	622.4
Silica (SiO_2)	6.0	9.2	15.6	9.6	12.4
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	1.0	0.86*	2.70*	0.54*	0.54*
Calcium (Ca)	75.9	10.0	45.0	62.8	35.7
Magnesium (Mg)	30.4	4.4	16.1	22.0	13.3
Sodium (Na) and Potassium (K) as Na	607.4	839.9	1970.9	1835.2	1317.9
Total Manganese (Mn)	0.00	0.03	0.08	0.04	0.10
Total Iron (Fe)	0.31				
Dissolved Iron	0.04	0.80	0.35	0.18	0.18
Precipitated Iron	0.27				
Sulfate (SO_4)	395.5	316.0	266.7	238.5	495.9
Chloride (Cl)	502.5	684.9	2540.9	2399.5	1312.4
Nitrate (NO_3)	1.4	1.02	0.0	0.0	0.0
Fluoride (F)	1.4	3.60	1.80	1.80	4.06
Total Suspended Matter	0.				
Total Dissolved Solids	1817.	2242.0	5236.0	4948.0	3599.0
Total Hardness	314.6	43.0	178.5	105.9	143.8
Carbonate Hardness	314.6	43.0	178.5	105.9	143.8
Non-carbonate Hardness	0.				
Percent of Alkalies	81	98	96	94	95

*Al_2O_3

A. Owner: Ralph Eckles, SE 1/4 NE 1/4 SE 1/4 sec. 11, T. 60 N., R. 35 W. Total depth 189 feet. Sample collected June 24, 1957 direct from the pump. Temperature of the water 58° F., of the air 81° F. Analyst: M. E. Phillips.

B. Owner: Charles Petroleum Co., Clark #1, SE 1/4 NW 1/4 sec. 28, T. 60 N., R. 35 W. Total depth 1435 feet bottomed in the St. Louis formation of the Mississippian System. Bailer sample from the Douglas of the Pennsylvanian System at a depth of 150 feet. Analyzed April 27, 1937 by R. T. Rolufs.

C. As above. Bailer sample from the Cherokee of the Pennsylvanian System from the depth interval 965 to 995. Analyzed April 6, 1937 by R. T. Rolufs.

D. As above. Bailer sample from the Cherokee of the Pennsylvanian System at a depth of 1015 feet. Analyzed April 7, 1937 by R. T. Rolufs.

E. As above. Bailer sample from Cherokee of the Pennsylvanian System at a depth of 1225 feet. Analyzed April 27, 1957 by R. T. Rolufs.

CONSTITUENTS	IN PARTS PER MILLION	
	F	G
Turbidity	Turbid	Turbid
Odor	None	Oily
pH		
Alkalinity ($CaCO_3$)	532.9	
Phenolpthalein		
Methyl Orange		
Carbonate (CO_3)	12.8	
Bicarbonate (HCO_3)	646.9	
Silica (SiO_2)	10.4	
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	0.59*	
Calcium (Ca)	30.0	
Magnesium (Mg)	16.2	
Sodium (Na) and Potassium (K) as Na	1166.4	
Total Manganese (Mn)	0.10	
Total Iron (Fe)		
Dissolved Iron	0.15	
Precipitated Iron		
Sulfate (SO_4)	556.8	462.3
Chloride (Cl)	1118.0	1365.4
Nitrate (NO_3)	0.0	
Fluoride (F)	4.70	
Total Suspended Matter		
Total Dissolved Solids	3423.0	3419.0
Total Hardness	141.4	
Carbonate Hardness	141.4	
Non-carbonate Hardness		
Percent of Alkalies	95	

*Al_2O_3

F. As above. Bailer sample from lower Cherokee of the Pennsylvanian System at a depth of 1375 feet. Analyzed April 27, 1937 by R. T. Rolufs.

G. As above. Bailer sample from bottom of test at 1433. Analyzed April 26, 1937 by R. T. Rolufs.

Referring to Plate 1, it will be noted that a large area of Andrew County is unfavorably located to obtain water from glacial drift. Wells drilled into the consolidated rock to moderate depths may possibly obtain limited yields of water of marginal quality. The water from "rock" wells in all probabilities will become more mineralized with increased depth of drilling.

QUALITY AND QUANTITY OF WATER FROM STREAMS

The following analyses is of a water sample collected October 25, 1955 from the Nodaway River near Nodaway, sec. 19, T. 59 N., R. 36 W. Temperature of the water was 57° F., of the air 69° F. Analyst: M. E. Phillips.

CONSTITUENTS	IN PARTS PER MILLION
Turbidity	100
Odor	none
pH	8.1
Alkalinity ($CaCO_3$)	229.0
Phenolpthalein	0.0
Methyl Orange	229.0
Carbonate (CO_3)	0.0
Bicarbonate (HCO_3)	279.4
Silica (SiO_2)	5.8
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	0.8
Calcium (Ca)	65.3
Magnesium (Mg)	17.0
Sodium (Na) and Potassium (K) as Na	15.7
Total Manganese (Mn)	0.00
Total Iron (Fe)	1.44
Dissolved Iron	0.06
Precipitated Iron	1.38
Sulfate (SO4)	24.1
Chloride (Cl)	6.3
Nitrate (NO_3)	0.2
Fluoride (F)	0.8
Total Suspended Matter	33.
Total Dissolved Solids	287.
Total Hardnes s	233.1
Carbonate Hardness	229.0
Non-carbonate Hardness	4.1
Percent of Alkalies	13

Of the streams flowing within or bordering Andrew County, only the Missouri River has flow adequate for extensive use under all weather conditions. No flow data is available for the streams of Andrew County.

QUALITY OF WATER FROM GLACIAL DRIFT

In general, the water from the glacial drift is high in total iron, total dissolved solids, and sulfates. The iron content in the water may cause staining of plumbing fixtures and laundry; however, relatively inexpensive water

treatment for the iron will prevent this staining. For most types of irrigation, total dissolved solids should not exceed 2000 parts per million and total alkalies should not exceed 75 percent. Most people cannot tolerate water for drinking purposes which contains more than 1500 parts per million of chloride, or 2000 parts per million sulfate. Water with 300 parts per million of chloride taste salty to some people. Sulfates in excess of 500 parts per million may have a laxative effect when first used for drinking.

Three of the samples of water as shown by three of the following analyses contained excessive nitrates. The following is quoted from the article, The Public Health Significance of High Nitrate Waters As a Cause of Infant Cynosis and Methods of Control, Metzler, D. F., and Staltenberg, H. A., Trans. Kansas Acad. Scie. Vol. 53, No. 2, p. 194 and 205, 1950.

"The cyonosis of infants can be caused by the ingestion of nitrates in the water used for making the feeding formula. The nitrates are converted to nitrates and absorbed by the blood, where they destroy its oxygen-carrying properties. The blood becomes chocolate brown, the skin develops a blue color and death may result from oxygen starvation." "Nitrate concentrations exceeding 10 to 20 ppm of nitrate nitrogen are considered unsafe."

The following are eight water analyses from glacial drift wells.

CONSTITUENTS	IN PARTS PER MILLION			
	1	2	3	4
Turbidity	6	1	4	Turbid
Odor	None	None	None	
pH	7.4	7.3	7.4	
Alkalinity ($CaCO_3$)	159.5	181.0	344.5	195.7
Phenolpthalein	0.0	0.0	0.0	
Methyl Orange	159.5	181.0	344.5	
Carbonate (CO_3)	0.0	0.0	0.0	4.2
Bicarbonate (HCO_3)	194.6	220.8	420.3	234.4
Silica (SiO_2)	20.3	18.5	19.8	5.6
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	1.0	0.8	1.3	0.80*
Calcium (Ca)	141.2	59.4	95.2	53.0
Magnesium (Mg)	24.3	16.4	30.5	15.6
Sodium (Na) and Potassium (K) as Na	56.7	27.7	53.5	23.4
Total Manganese (Mn)	0.40	0.00	0.00	
Total Iron (Fe)	0.24	0.15	1.24	
Dissolved Iron	0.04	0.04	0.04	
Precipitated Iron	0.20	0.11	1.20	
Sulfate (SO_4)	123.6	44.0	64.8	20.6
Chloride (Cl)	82.0	5.8	7.0	4.2
Nitrate (NO_3)	94.2	27.6	30.5	
Fluoride (F)	0.4	0.5	0.5	
Total Suspended Matter	18.	0.	2.	
Total Dissolved Solids	785.	327.	521.	265.0
Total Hardness	452.6	215.8	363.2	196.5
Carbomate Hardness	159.5	181.0	344.5	195.7
Non-carbonate Hardness	293.1	34.8	18.7	
Percent of Alkalies	21	22	24	21

*Al_2O_3, Fe_2O_3

1. Owner: Hoyt Hoskins, SW 1/4 NE 1/4 SE 1/4 sec. 10, T. 61 N., R. 35 W. Total depth 30 (?) feet. Sample collected from pressure system June 24, 1957. Analyst: M. E. Phillips.

2. Owner: Melvin Hurst, NW 1/4 NW 1/4 SW 1/4 sec. 28, T. 61 N., R. 35 W. Total depth 70 feet. Sampled from pressure system June 26, 1957. Analyst: M. E. Phillips.

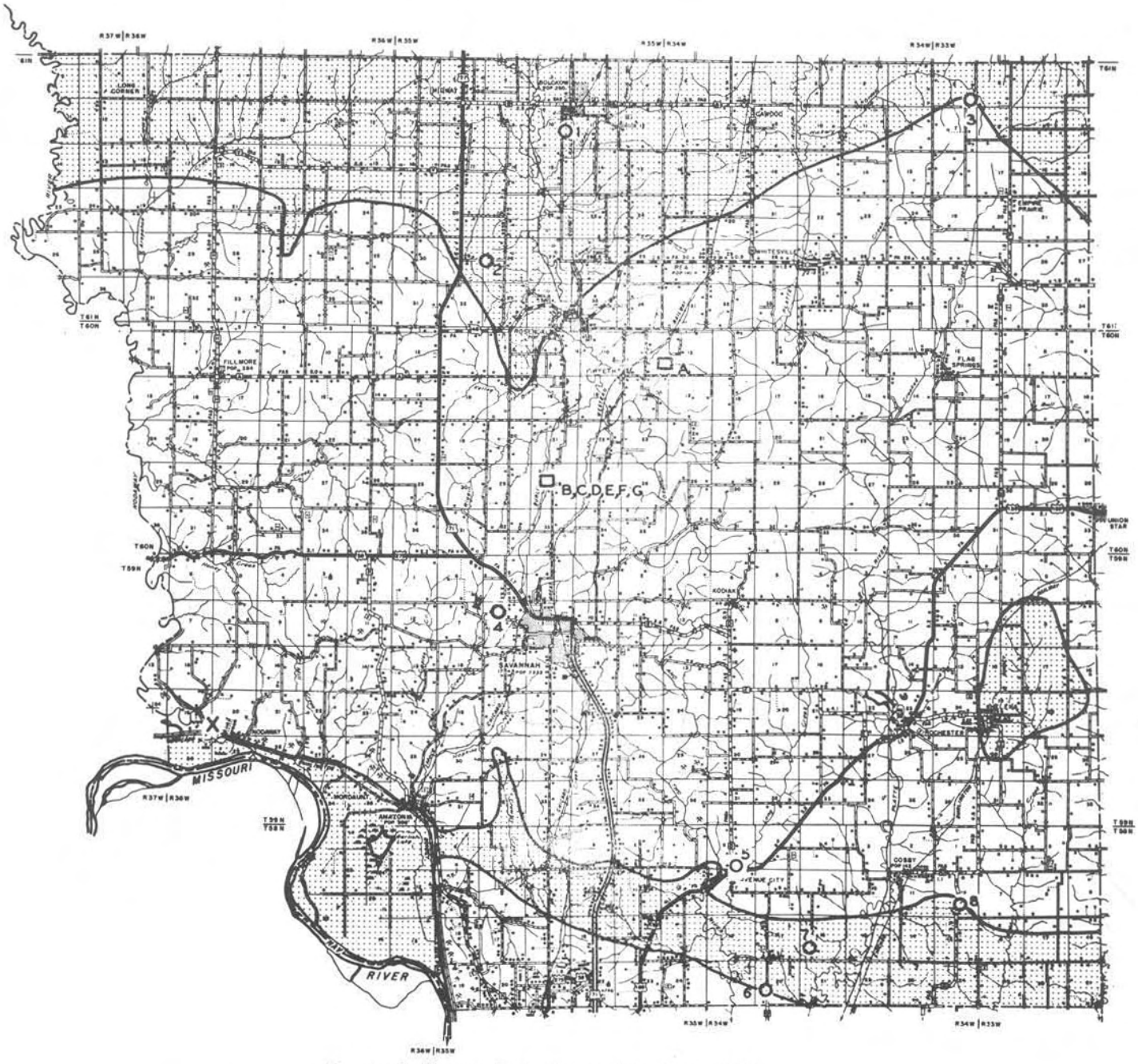
3. Owner: William Van Heel, SE 1/4 SW 1/4 SE 1/4 sec. 6, T. 61 N., R. 33 W. Total depth 40 feet. Sampled from the pump June 24, 1957. Temperature of the water 58° F., of the air 87° F. Analyst: M. E. Phillips.

4. Owner: City of Savannah, NW 1/4 SE 1/4 NW 1/4 sec. 8, T. 59 N., R. 35 W. Total depth 114 1/2 feet bottomed in the Pennsylvanian System. Water samples from glacial drift from the 70 to 80 foot interval. Analyzed April 26, 1941 by R. T. Rolufs.

CONSTITUENTS	IN PARTS PER MILLION			
	5	6	7	8
Turbidity	1 -	4	20	30
Odor	None	None	None	None
pH	7.45	7.5	7.35	7.4
Alkalinity	144.5	320.5	273.5	365.0
Phenolpthalein	16.0	26.0	0.0	0.0
Methyl Orange	128.5	294.5	273.5	365.0
Carbonate (CO_3)	9.6	15.6	0.0	0.0
Bicarbonate (HCO_3)	156.8	359.3	333.7	445.3
Silica (SiO_2)	21.2	19.0	19.2	23.3
Oxides (Al_2O_3, Fe_2O_3, TiO_2, etc.)	0.6	1.5	0.8	0.8
Calcium (Ca)	36.0	114.9	81.5	91.4
Magnesium (Mg)	7.6	23.9	14.7	26.8
Sodium (Na) and Potassium (K) as Na	23.6	30.2	22.1	31.0
Total Manganese (Mn)	0.00	0.26	0.33	0.40
Total Iron (Fe)	0.21	0.57	1.33	3.80
Dissolved Iron	0.04	0.04	0.06	0.08
Precipitated Iron	0.17	0.53	1.27	3.72
Sulfate (SO_4)	4.0	84.9	12.8	17.4
Chloride (Cl)	4.3	3.3	3.0	0.8
Nitrate (NO_3)	0.0	0.1	0.0	0.0
Fluoride (F)	0.2	0.2	0.3	0.3
Total Suspended Matter	0.	0.	28.	11.
Total Dissolved Solids	192.	487.	327.	425.
Total Hardness	121.2	385.3	264.0	338.6
Carbonate Hardness	121.2	320.5	264.0	338.6
Non-carbonate Hardness	0.	64.8	0.	0.
Percent of Alkalies	30	14	15	17

5. Owner: Avenue City School, SE 1/4 SW 1/4 SE 1/4 sec. 6, T. 58 N., R. 34 W. Total depth 58 feet. Sample collected from the pressure tank June 12, 1957. Analyst: M. E. Phillips.

6. Owner: Alfred Sommer, SE 1/4 NW 1/4 SW 1/4 sec. 20, T. 58 N., R. 34 W. Total depth 125 feet. 10 gallons per minute, static water level 70 feet. Sampled collected from pressure system June 12, 1957. Analyst: M. E. Phillips.



Base by the Missouri State Highway Department, 1953

LEGEND

- Area most favorable
- O_4 Location of wells in drift and alluvium from which water was analyzed
- $\square_B$ Water sample analyzed from a "rock" well
- X Water sample analyzed from a stream

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PLATE 1

MAP OF

ANDREW COUNTY

SHOWING

AREA MOST FAVORABLE FOR THE DEVELOPMENT OF WELLS IN DRIFT AND ALLUVIUM

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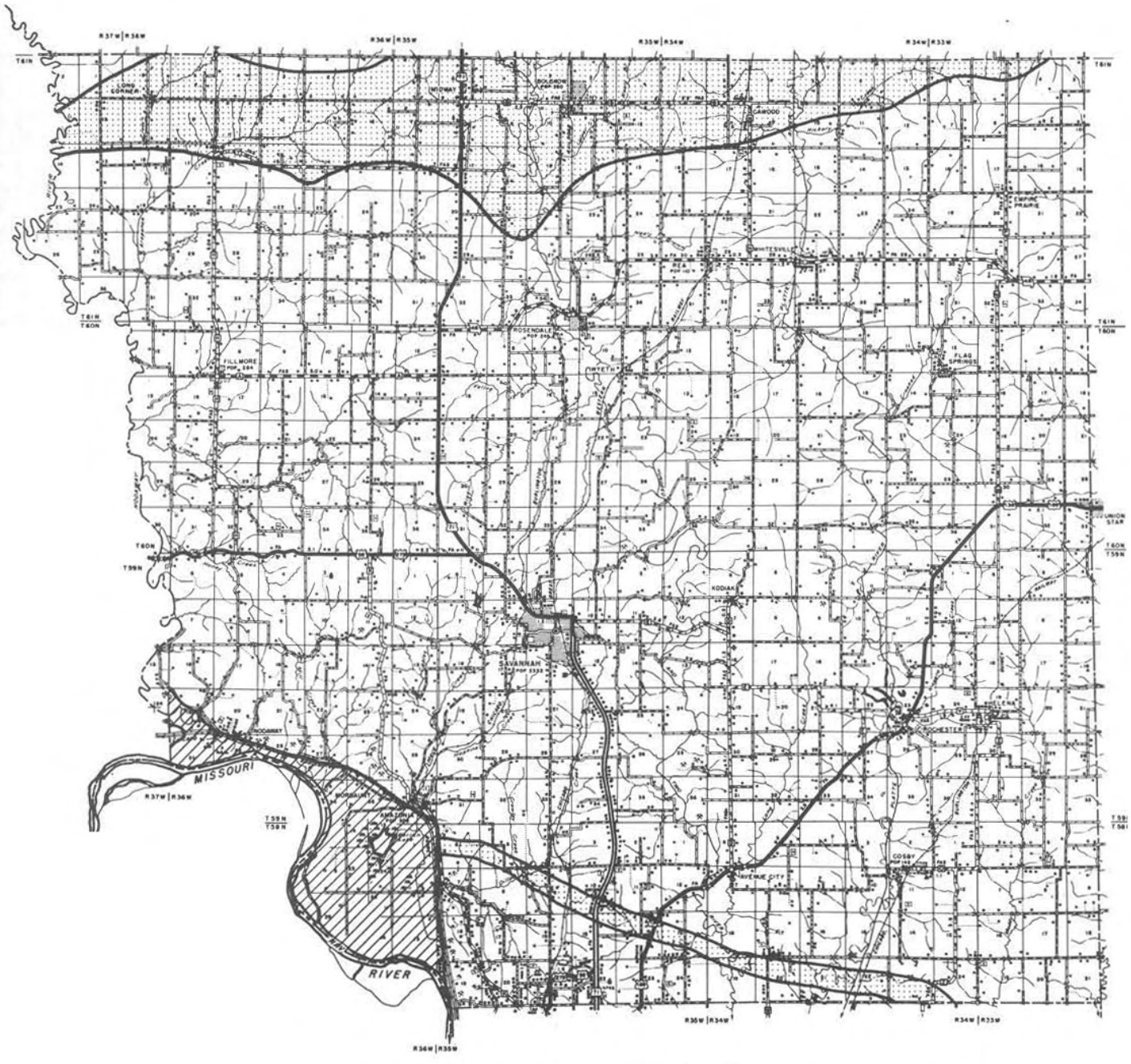

Base by the Missouri State Highway Department, 1953

LEGEND

Alluvial filled valley

Drift filled valley—generally unsuitable for irrigation

—N—

PLATE 2

MAP OF

ANDREW COUNTY

SHOWING

ALLUVIAL FILLED VALLEY IN WHICH IRRIGATION WELLS POSSIBLY CAN BE DEVELOPED

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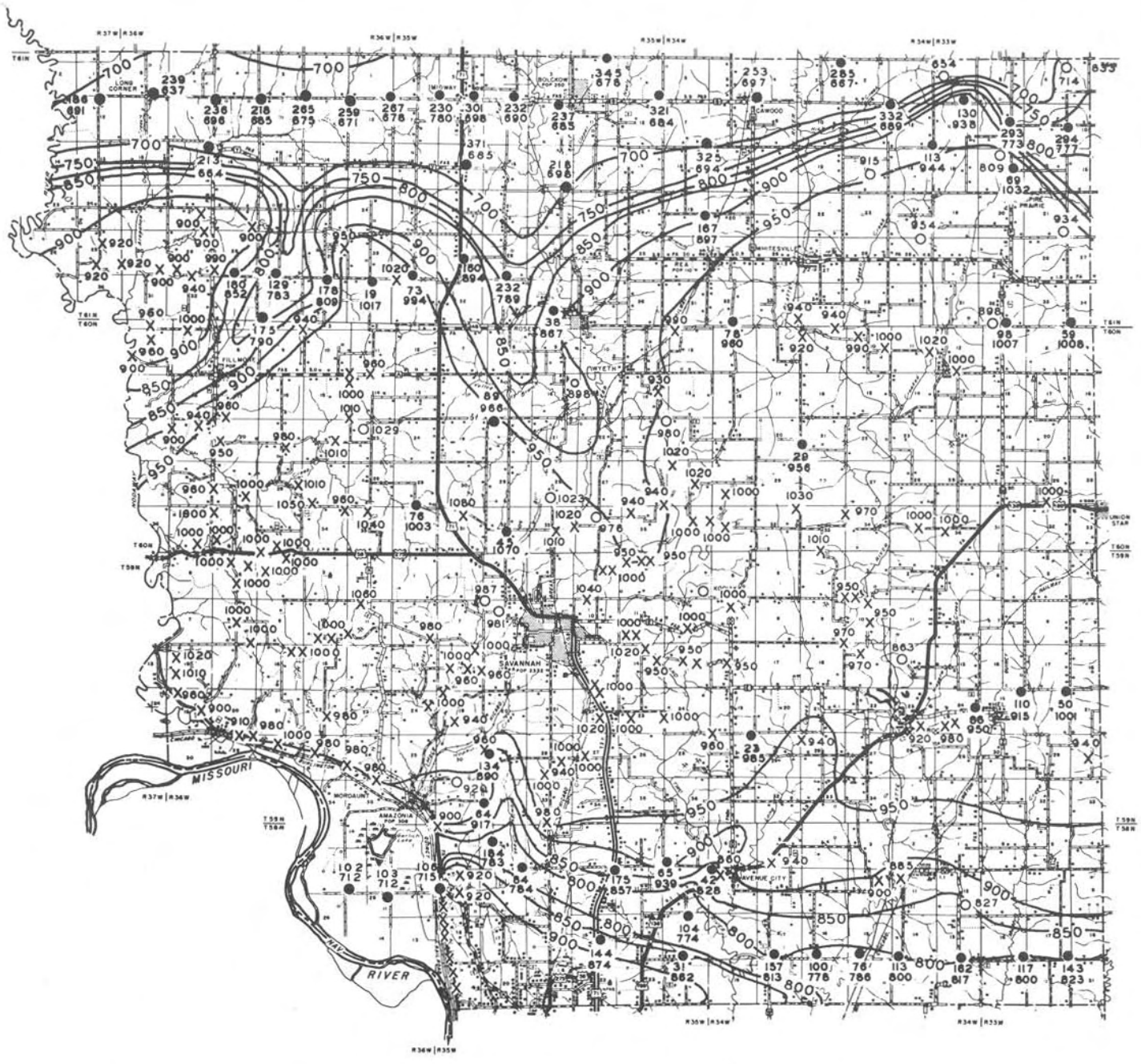

Base by the Missouri State Highway Department, 1953

LEGEND

- ●135 / 650 — *Test holes showing thickness in feet of drift and elevation of bedrock above sea level*
- ○ — *Water wells*
- X — *Bedrock Outcrops*
- ⚒ — *Mine or Quarry*
- 920 — *Indicates outcrop elevation*

N

MAP OF

ANDREW COUNTY

CONTOURED TO SHOW

BEDROCK ELEVATIONS

BY

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PLATE 3

7. Owner: Raymond Schneider, SE 1/4 NW 1/4 SW 1/4 sec. 16, T. 58 N., R. 34 W. Total depth 94 feet. Collected from pressure system June 24, 1957. Analyst: M. E. Phillips.

8. Owner: Glen Harr, SW 1/4 NW 1/4 SE 1/4 sec. 12, T. 58 N., R. 34 W. Total depth 183 feet. Sample collected from pressure system, June 24, 1957. Analyst: M. E. Phillips.

QUANTITY OF WATER FROM GLACIAL DRIFT AND ALLUVIUM

DOMESTIC WELLS - Included in this category are wells developed for household or general farm use. Yields required from domestic wells vary but seldom exceed 15 gallons per minute. In some parts of Andrew County sands and gravels were not deposited in the glacial drift. There are also areas where the glacial drift cover is relatively thin or lacking. In such areas the possibility of developing wells is limited. Plate 1 shows the area most favorable for the development of domestic wells. Plate 3 is a contour map showing the elevation of bedrock above sea level. To determine probable drilling depths, the elevation of the bedrock should be subtracted from the surface elevation for each specific site. Plate 3 shows the locations of the test holes and the thickness of the glacial drift encountered.

IRRIGATION WELLS - Included in this category are all high yield wells whether used by cities, by industries, or for irrigation. Plate 2 shows the area most favorable for the development of irrigation wells.

With proper development, yields of 200-1000 gallons per minute may be obtained. Yields to be expected are contingent upon several factors:

(1) The thickness of the sand and gravel beds.
(2) The size and sorting of the sand and gravel beds.
(3) The manner of construction and materials used, such as proper well screen, gravel pack, etc.
(4) Ability of the well driller to develop the full capacity of the water bearing sands.

Continued successful production is contingent upon:

(1) Re-charge rate of the water-bearing horizons.
(2) Quality of the screen and materials used.
(3) Subsequent well treatment such as acidizing.
(4) Avoidance of over-pumpage.

SUMMARY

Approximately 8,000 acres of Andrew County are located within the area in which irrigation wells possibly can be developed. Nearly one-fourth of Andrew County's area is suitably located for obtaining water sufficient for domestic needs from the glacial drift.

Questions concerning water problems for a specific location should be sent to the Missouri Geological Survey, Rolla, Missouri.